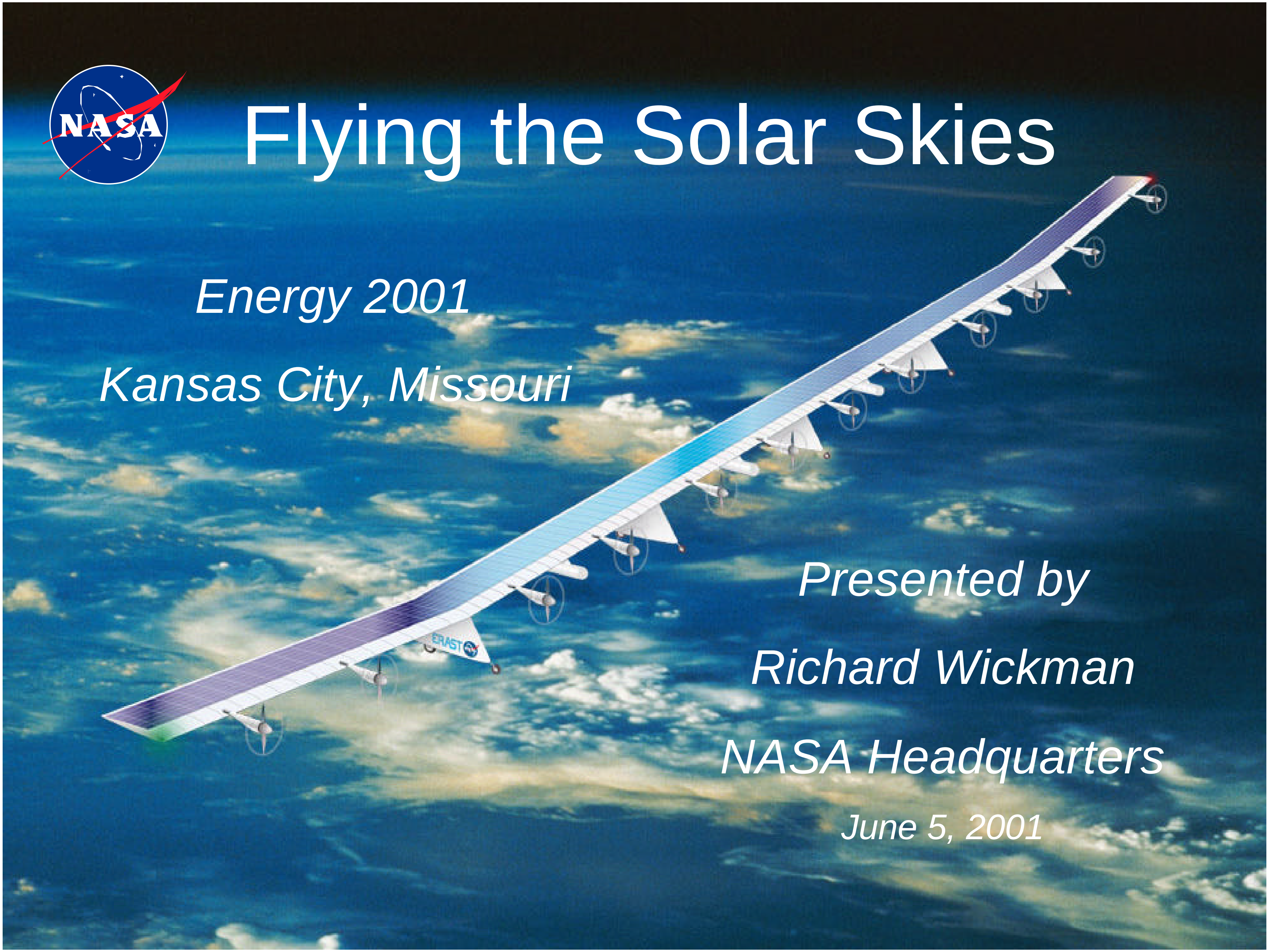
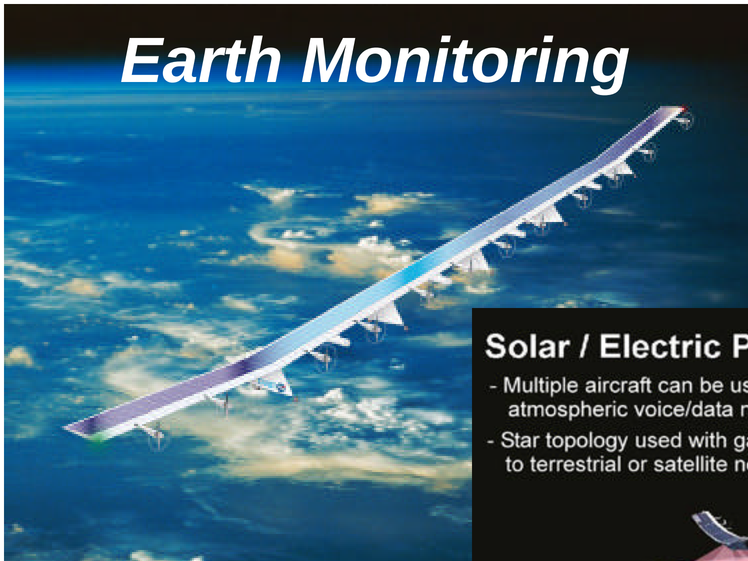
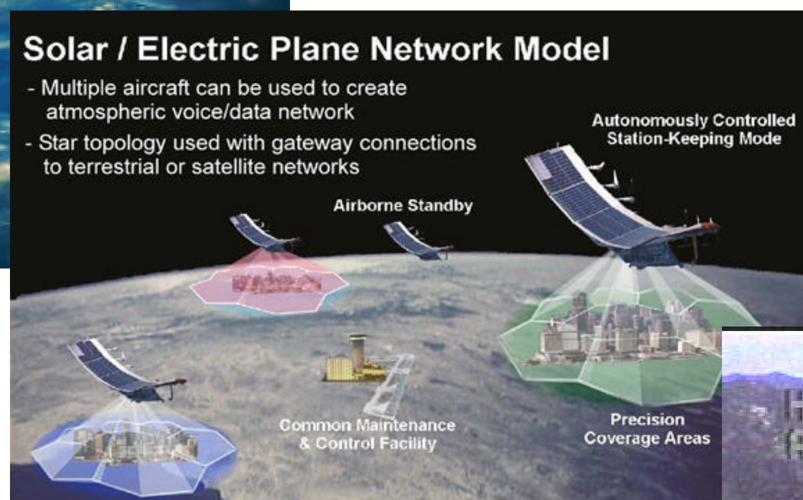

Flying the Solar Skies
Energy 2001
Kansas City, Missouri
Presented by
Richard Wickman
NASA Headquarters
June 5, 2001

The Endeavor



Develop solar aircraft technology to open the door to low cost ultra-long duration high altitude flight.



Focus on:

Efficiency

Reliability

Redundancy

The ERAST Project

- The Environmental Research Aircraft and Sensor Technology (ERAST) Project was initiated in 1995.
- ERAST Objectives
  - Support development of Uninhabited Aerial Vehicle (UAV) capabilities: very high altitude (90 - 100K ft.); high altitude- long endurance (60K ft.- 8 hrs.) and extreme duration (>96 hrs.)
  - Develop new miniaturization and automation approaches for airborne sensors
  - Effectively transfer (UAV) technology to US industry to establish competitive capabilities
- Approach
  - Formulation of an alliance with industry, other US Government agencies, and academia
  - Utilize unique flight techniques and capabilities to demonstrate critical technologies
  - Perform major flight demonstrations & science missions using UAVs

Solar Aircraft Evolution

Gossamer Penguin

(Circa 1979)

Pathfinder

(Circa 1995)

Pathfinder Plus

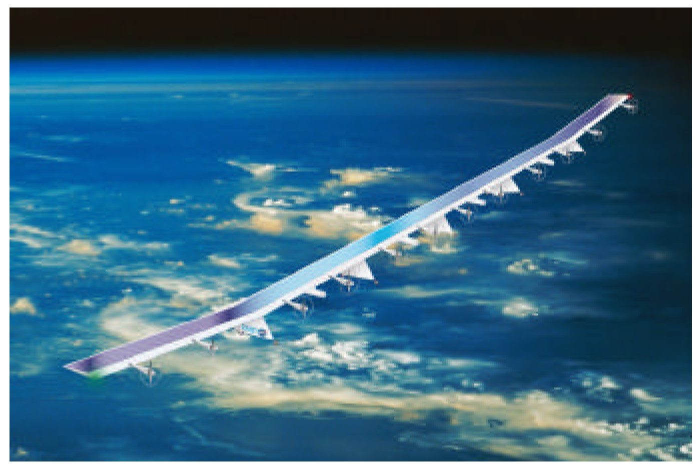
(Circa 1998)

Centurion

(Circa 1999)

Helios Prototype

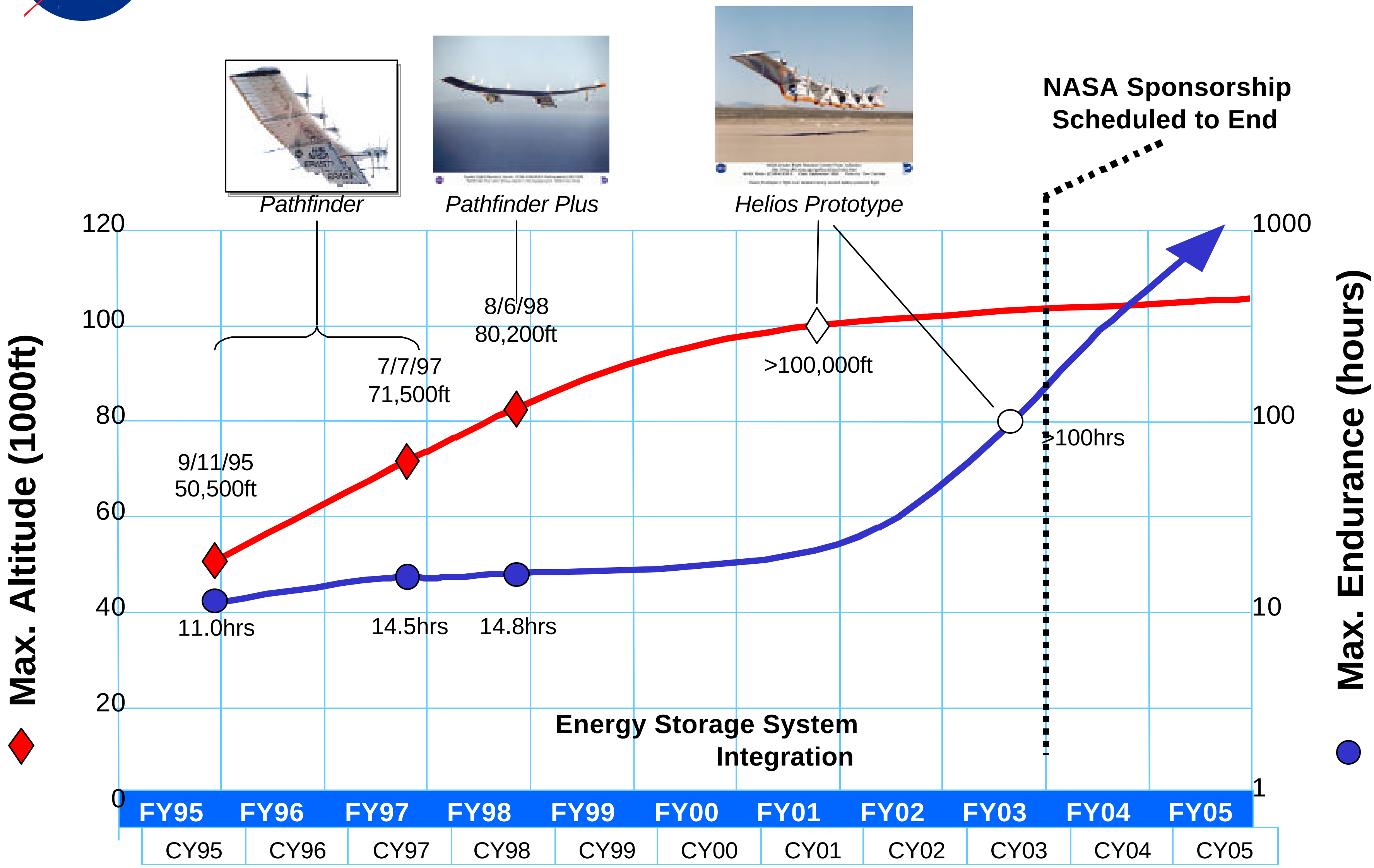
(Today)



Earth Monitoring Aircraft

(2005 and Beyond)

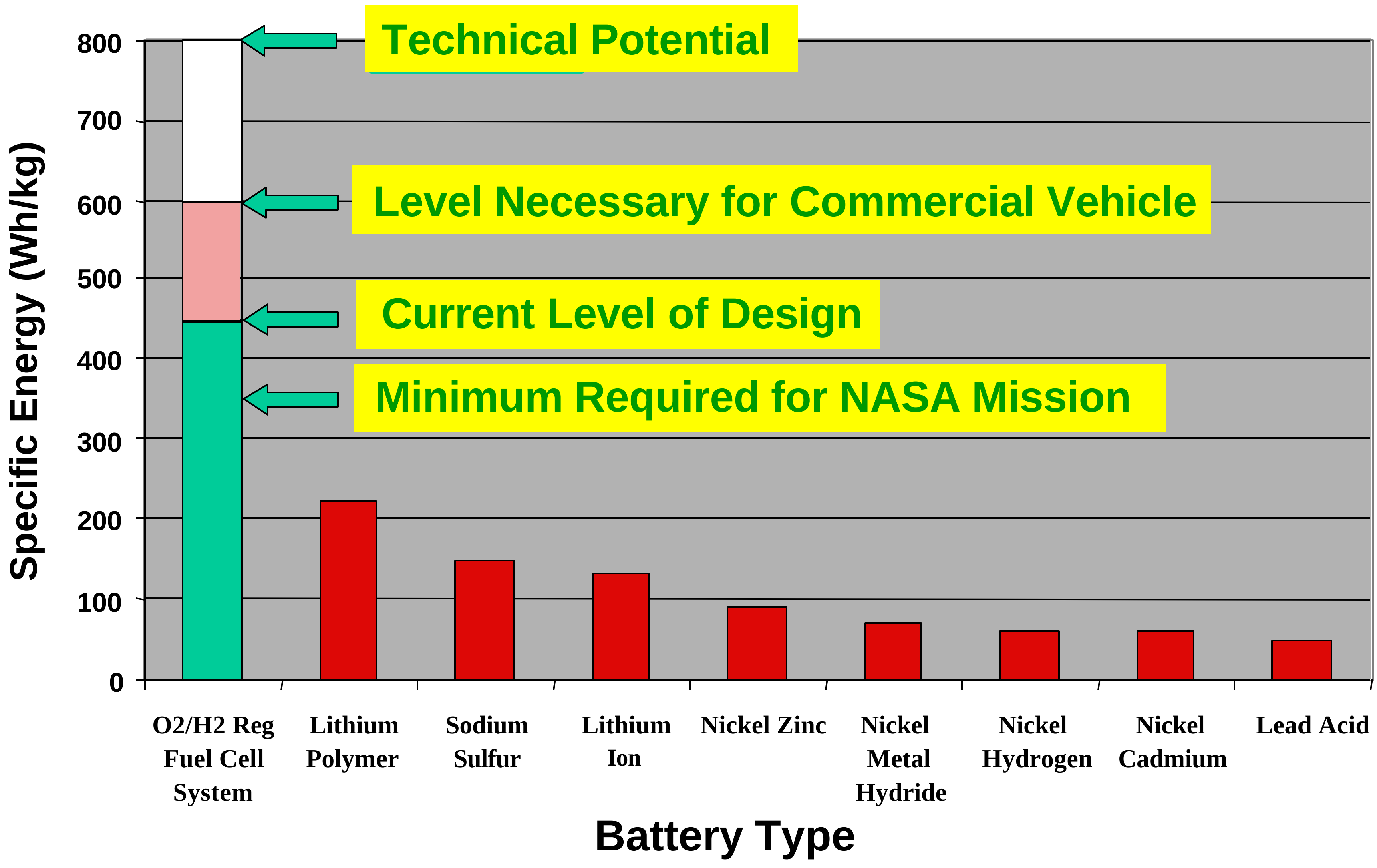
Solar Powered Aircraft Road Map



Pathfinder Plus
&
Helios Prototype

- ***Pathfinder+ is World Altitude Record holder - over 80,000 ft***
- ***Next NASA milestone is to reach 100,000 ft with Helios***

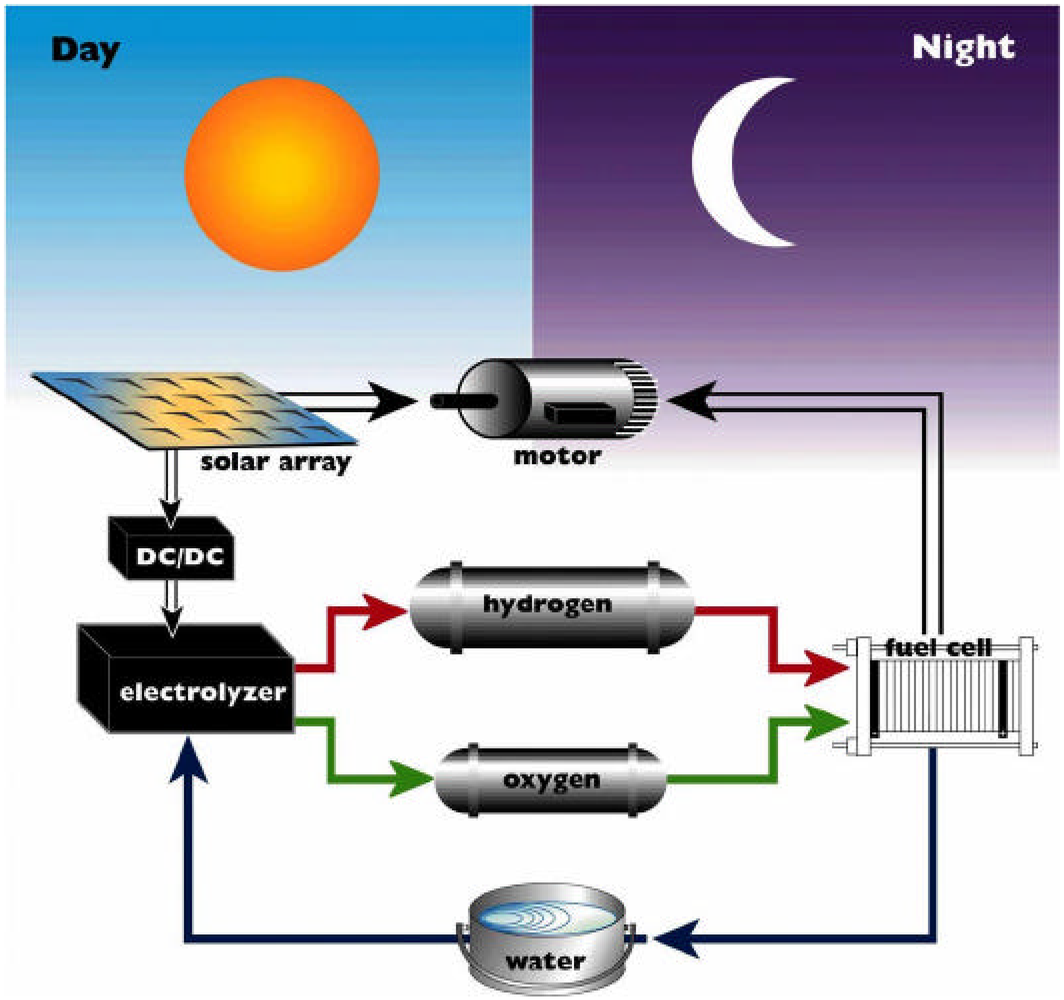
Comparison of Rechargeable Energy Storage Systems



Regenerative Fuel Cell Energy Storage System Summary

Day Cycle

- Sun energy converted to electricity by Solar Cells
- Half of electricity goes to Motor to propel plane
- Other Half of electricity goes to Electrolyzer to convert water into Hydrogen and Oxygen fuel



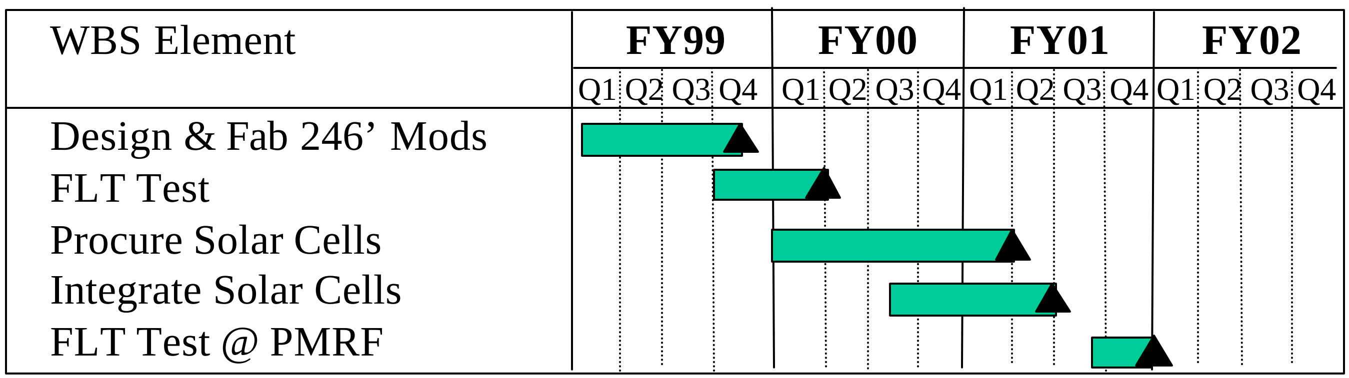
Night Cycle

- Oxygen and Hydrogen combine in Fuel Cell to produce electricity to propel plane
- Water from Oxygen and Hydrogen stored until next day

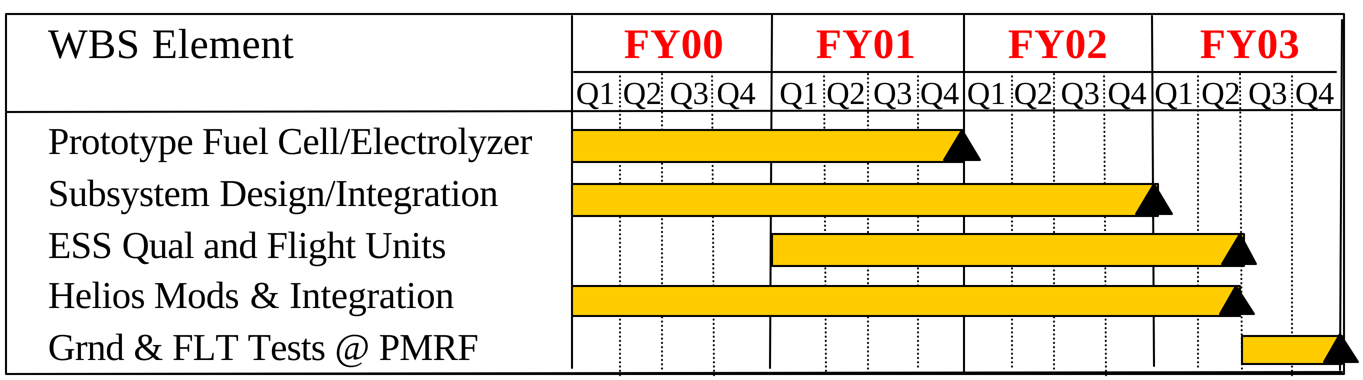
Fuel cell energy storage system enables continuos flight through night

NASA Schedule for Helios

Goal 1: **Develop and fly a prototype solar powered UAV at or above 100,000ft**



Goal 2: **Develop and fly a prototype solar power UAV capable of sustaining 96 hrs above 50,000’**



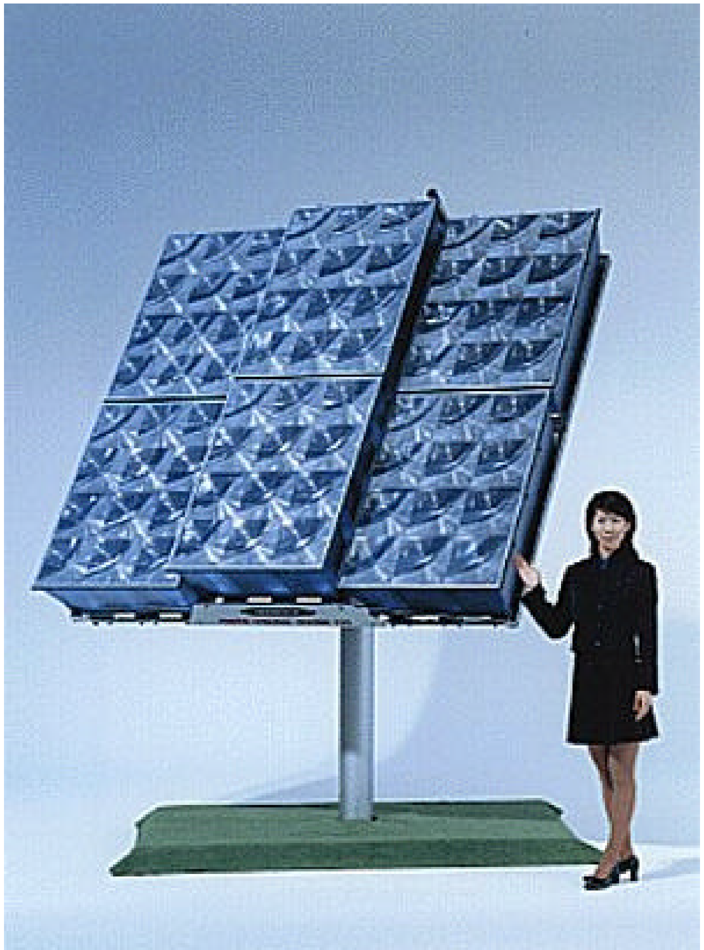
Helios Prototype Summary

- 247-ft wingspan (greater than a 747 jumbo jet)
- Weighs under 2,000 lbs (less than most automobiles)
- Take off speed of 25 mph, cruises at 60 to 90+ mph
- Environmentally benign - zero pollutants!
- 35 kW Solar Array using 18.3% efficient solar cells
- Eight 2hp Electric Motors

- Designed for operation to 70,000 ft.
- Six Wing Sections
- Five Landing Gear Pods
- Carbon/Kevlar Fiber Construction
- Fixed Landing Gear
- Redundant Flight Critical Sensors
- Redundant Datalinks

Terrestrial Application

- *Project Oasis* at NASA Dryden Flight Research Center, Edwards, CA
- Concentrating Solar PV
- High Efficiency Cell under Low-Cost Fresnel Lens
- Power Output Curve Coincides with Typical Electrical Load Curve
- Feasibility Study Underway for 3-4 MW Grid-Connected PV System



Video: History of Solar Powered Flight

Approximately

10 minutes long

Produced by NASA Dryden PACE Office